3.8 SOILS

Motorized routes (roads and trails) provide necessary access for forest management activities and public recreation. However, motorized routes lead to a loss of soil productivity within the route footprint. Productive soil horizons are lost when a route is established, whether through active construction or continual use over time. In addition to the loss of organic matter and topsoil, soils become compacted on the route surface, which reduces or eliminates rooting capacity, water infiltration, and microbiological activity. Loss of soil productivity can result in ponding of water, surface runoff, and erosion. Maintenance is necessary to address these issues, specifically surface runoff and erosion.

Soil productivity is a highly site-specific variable which is dependent on a number of climatic characteristics and soil forming factors that occur at very small scales. Soil productivity can vary from one square foot to the next with each area functioning independently. Thus, the highly variable and independent nature of soil productivity requires site-specific analyses to maintain the proper context. Focused soils analysis has been completed for new route construction and also for motorized access to dispersed campsites within the proposed motorized access corridors for the alternatives. Soil analysis for routes located on high erosion potential soils has been completed based on the area covered by specific Forest system routes.

Impacts to soil productivity resulting directly from the presence of system roads and trails are not evaluated for compliance with Forest Plan and R1 Standards and Guidelines because the affected land is managed for transportation (National Forest Roads and Trails Act of 1964 – see Section 3.8.2 of this FEIS). Region 1 Soil Quality Standards (R1 SQS) state that "Permanent roads do affect soil-hydrologic function, however, their evaluation is more appropriately done on a watershed basis using models and other watershed analysis techniques." Please refer to the Water Resources analysis, Chapter 3, Section 3.6, for further discussion. Under current conditions, soil productivity has been withdrawn on lands affected by about 2,601 miles of existing motorized routes across the Bitterroot National Forest. These dedicated roads and trails are referred to as the "Forest Transportation System."

Losses of soil productivity from motorized uses can also occur when users establish unauthorized routes by creating shortcuts, avoiding trail obstructions, accessing dispersed campsites, and crossing difficult terrain or wet areas. Typically off-road travel by motorized users is prohibited, and unauthorized routes are rehabilitated and closed. However, access to dispersed campsites is an exception. Analysis in this travel management process includes potential impacts to soils from access to dispersed campsites by alternative. Analysis included soils that may be sensitive and more readily disturbed when accessing campsites with motorized vehicles.

Beyond the loss of soil productivity, processes such as erosion may occur on routes, which can affect water resources through sedimentation, which is the production, deposition, or accumulation of sediment. Most primary roads have been engineered and designed to limit erosion and sedimentation. Soils sensitive to erosion can erode much more readily if the route is not properly maintained. Soils sensitive to erosion are discussed in relation to travel management.

3.8.1 SCOPE OF ANALYSIS AND ANALYSIS METHODS

Loss of soil productivity is the greatest concern for the soil resource in the travel management process. Soil productivity includes the inherent capacity of a soil under management to support the growth of specified plants, plant communities, or a sequence of plant communities. Miles of proposed new construction and acres of soils impacted from new route construction was selected as the measurement indicator for soil productivity. The analysis area for the new construction includes the acres of soil productivity lost to route construction (based on 20 foot wide road prism).

Soils sensitive to impacts from accessing dispersed camping sites with motorized vehicles have also been analyzed for the alternatives. Soils sensitive to motorized access to campsites include ash cap soils, high

erosion potential soils, hydric (wetland soils), and landslide/slump prone soils. The proposed motorized wheeled access corridors for the alternatives served as the analysis areas for potential soil disturbance from motorized access to dispersed campsites. Analysis methods include spatial modeling in Geographic Information Systems (GIS).

Miles of existing motorized routes on soils sensitive to erosion have been analyzed to identify areas where erosion may be more prevalent on routes and could lead to watershed impacts. Higher levels of maintenance are typically required on routes constructed on erodible soils. Soil analysis for routes located on high erosion potential soils has been completed on an analysis area based on the Bitterroot National Forest's boundary, excluding Designated Wilderness.

3.8.2 REGULATORY FRAMEWORK

The National Forest Roads and Trails Act of 1964 authorized the Forest Service to establish and maintain a network of roads and trails on National Forest System lands. Implicit in this legal direction is Forest Service authority to withdraw lands from vegetation production and related soil productivity on National Forests for dedication to road and trail corridors for transportation and access uses. In this context, impacts to soil productivity resulting directly from the presence of roads and trails are not evaluated for compliance with Region 1 Soil Quality Standards (R1 SQS), because the affected land is managed for transportation uses rather than vegetation production. Therefore, analyses of soil resources provide background information for better understanding of watershed impacts from roads and trails on the Bitterroot National Forest.

Executive Order (E.O.) 11644 (February 8, 1972), as amended by E.O. 11989 (May 24, 1977) addressed OHV use on public lands. The order established direction for the management of OHV use, and provides for closing areas to OHVs where resources would, or are, being negatively impacted.

General guidance on management of soil resources is included in the Bitterroot National Forest Plan and the R1 SQS {Project File folder 'soils,' Project File document SOILS-001.pdf}.

3.8.3 AFFECTED ENVIRONMENT

A. Loss of Soil Productivity on Forest Routes

The Bitterroot National Forest currently has approximately 2,601 miles of motorized system routes. Soil productivity was lost when these routes were initially constructed. Assuming an average route footprint of 20 feet in width, approximately 6,305 acres have been removed from the productive land base as part of the forest transportation system. Based on this analysis, the Forest's Transportation System occupies less than 0.5 percent (.005) of the Bitterroot National Forest's land base.

B. Watershed Implications - Routes on Soils Sensitive to Erosion

Erosion occurs when energy from wind, rainfall, and runoff is sufficient to detach and move soil particles. Erosion and sediment occur in all watersheds as a natural geologic phenomenon. Blowdowns commonly occur during high wind conditions; they cause displacement of soils and expose mineral soils to erosion depending on landscape position. Flooding can cause soil erosion and decrease productivity in heavily eroded areas or areas where sediment deposition buries productive soils. Mass movements in the form of debris torrents and debris avalanches reduce soil productivity by displacing productive soil horizons. Typically during mass movement, soils are completely eroded to bedrock or impermeable layers. All of these natural events are expected to continue within their current range of variability.

Most roads and trails have been engineered and designed to limit erosion and sedimentation. However, management activities associated with roads, trails, and cross-country motor vehicle use can accelerate erosion and sediment beyond the historic range of variation and geological rate (Satterlund and Adams 1992). Erosion can also be increased for short durations by natural disturbance events. Accelerated erosion and sediment delivery from trails follow the same processes that occur from roads. The primary source of

erosion and sediment is the trail itself, with accelerated erosion occurring once vegetative cover is lost. The extent of erosion is primarily determined by trail location and complex interaction between topographic, soil, and geomorphic features (Wilson and Seney 1994). Motorized trails have less impact due to the smaller prism, but the travel way is usually bare and compacted, which increases the probability of runoff and risk of erosion.

Erosion will also increase based on the use that occurs on a route. Hiker, horse, and wheeled-vehicle use all increase erosion depending on the location, amount of use, and type of use. Erosion increases with compaction, particle detachment, and channelization. Weaver and Dale (1978) found that horses caused greater increases in soil compaction, litter, trail width, and depth compared to hikers and motorcycles. Studies in Montana have shown that horses and hikers make more sediment available due to detachment than motorcycles and off-road bicycles (Wilson and Seney 1994). Meyer (2002) has documented that wheeled vehicles will increase erosion from compaction, surface subsidence, and wheel shearing and pumping.

There are an undetermined number of miles of unauthorized routes on the Forest, which are being used primarily by ATVs and motorcycles. Unauthorized routes are not engineered or constructed to Forest Service standards. They are often located on steep grades or in boggy areas. Due to the lack of consideration for resource effects during their creation, most unauthorized routes are more prone to rutting and erosion, and sediment production than system routes. However, the Forest Service cannot expend funds to maintain or improve unauthorized routes; maintenance and improvements are intended to ensure the integrity of travel routes. Consequently, conditions on these routes will continue to deteriorate as erosion creates deeper ruts and exposes more rocks, resulting in resource and safety concerns.

The erodibility factor (Kw) quantifies the susceptibility of soil particles to detachment and movement by water. The Kw factor is adjusted for the effect of coarse fragments. Kw ranges from 0 to 0.43 for Bitterroot National Forest soils with 0.43 being the most erodible. In this analysis, soils with a Kw value greater than or equal to 0.20 are considered soils with potential for excessive erosion. Granitic soils tend to have high Kw values and are prevalent across much of the Bitterroot National Forest due to the presence of the Idaho batholith. Granitic soils vary in the degree of erodibility due to overall texture, structure, organic matter content, and amount of coarse fragments. Other factors that affect erosion rates of granitic soils include vegetative cover, slope, and location on the landscape. Granitic soils of greatest concern for excessive erosion are formed from highly decomposed granite known as gruss. These soils have very little cohesion and structure and are eroded easily. Motorized travel on these soils can lead to soil deformation and erosion even during dry conditions due to the rapid decomposition of the granitic parent material.

Table 3.8-1 displays the miles of routes that occur on soils with high erosion potential.

Table 3.8- 1: High Erosion Potential Soils Traversed by Currently Open Motorized System Routes

Soils with Potential for Excessive Erosion (Kw values >= 0.2)	Landtype/Soil Description	Miles of System Routes
21UE2	Ash cap colluvium and glacial drift on ground moraines	<1
30M70	Colluvium over residuum on steep mountain slopes (40-60% slope)	4
31K37	Colluvium over residuum on dissected mountain slopes (40-60% slope)	23
32B30, 32K31, 32M70, 32M71	Colluvium on moderately steep mountain slopes	77

Soils with Potential for Excessive Erosion (Kw values >= 0.2)	Landtype/Soil Description	Miles of System Routes
	(20-40% slope)	
43H43	Residuum, rock outcrop on steep glaciated mountain slopes and ridges	<1
61M70	Colluvium over residuum on steep break land slopes (60-80% slope)	4
Total Miles		**107**

Approximately 107 miles of existing routes are located on soils with high erosion potential (approximately 4 percent of the Forest's Transportation System). Analysis is included in {Project File document SOILS-005.pdf}. The soils in Table 3.8-1 are derived from granitic parent materials. Granitic soils typically have a sandy-to-sandy loam texture that has little cohesion.

Landtype plays a major role in the erodibility of the soils in Table 3.8-1. Landtypes are a fine scale unit of a hierarchical ecological framework. Landtypes represent geology, soils, geomorphology, vegetation, and many other ecological data depending on mapping intensity. Many of these soils are located on landtypes that have slopes steeper than 40 percent. Soil and landtype mapping information is included in the Bitterroot National Forest Soil Survey (NRCS MT647). This information can be accessed on the NRCS Web Soil Survey at http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm. Motorized routes are typically not constructed to exceed 20 percent gradient. Minimizing trail gradient steepness greatly reduces the potential for erosion. Best Management Practices (BMPs) are often implemented to minimize runoff on the surface of a route. Diversions, waterbars, cross drains, culverts, hardening of the surface, and out sloping are a few examples of BMPs that are installed on routes to slow water flow and reduce the distance it travels on a route surface. The longer the distance and the faster water flows across the surface of a route, the more erosion occurs regardless of soil type.

Maintenance efforts are focused in these areas to correct runoff problems and reduce erosion. However, erosion will still occur, and can sometimes be excessive, based on precipitation patterns. For example, localized thunderstorms capable of releasing two inches of precipitation in less than one hour often lead to erosion regardless of soil type on the route. Further discussion on erosion and sedimentation in watersheds is provided in the Water Resources section, 3.6, of this FEIS.

C. Soils Sensitive to Off Route Motorized Travel

Soils considered sensitive to off-route disturbance from motorized vehicles include:

- Ø ash cap soils
- Ø high erosion potential soils
- Ø hydric or wetland soils
- Ø landslide or slump prone soils

Ash cap soils consist of a thin layer of ash (1 – 2 inches thick) that is found below the duff and organic horizons on various soil types. The ash is critical to the productivity of these soils and, if disturbed, can greatly impair the productivity of the soil. These soils are especially sensitive to motorized travel. Several passes by motorized vehicles can compact these soils and expose the ash layer, which is highly erodible.

High erosion potential soils were described in Section 3.8.3 B.

Hydric or wetland soils are those that are saturated throughout all or the majority of the year. These soils are indicators of wetland areas. Hydric soils and wetlands may not always be recognized since they can exist in areas where no ponded water is present. They can be highly disturbed by as little as one pass with motorized equipment due to the rutting of soils. These soils are often found on low lying, level (or nearly level) areas. Rutting and compaction in these soils greatly disturbs wetland vegetation and the subsurface flow of water, often resulting in the unintended ponding of water. Detrimental rutting is defined as wheel ruts at least 2 inches deep in wet soils and detrimental compaction is a 15 percent increase in natural bulk density {Project File document SOILS-001.pdf}. Ponded water may lead to surface runoff and off site erosion. Ponded water also increases evaporative loss which may reduce available water and greatly affect the hydrologic function in wetland areas especially during hot and dry periods.

Landslide and slump-prone soils are sensitive to motorized travel due to changes in hydrologic function from compaction and displacement of soils. Detrimental displacement is the removal of 1 or more inches (depth) of any surface soil horizon, usually the A horizon, from a continuous area greater than 100 square feet {Project File document SOILS-001.pdf}. Compaction of soils in high risk mass movement areas can impede the flow of water through soil which can create areas of excessive saturation. Displacement of soils can increase infiltration due loss of organics and vegetation which remove water from the soil through transpiration. The weight of excess saturation in these soils can exceed the soil's shear strength, and lead to slumping and landslides on slopes.

The following table, Table 3.8-2, shows the acres of sensitive soils types in the analysis area:

Table 3.8- 2: Acres of Sensitive Soils

Sensitive Soil Types	Acres
Ash Cap	8,400
High erosion potential	6,753
Hydric soils	139
Landslide/slump-prone soils	1,895
Total Acres of Sensitive Soils	**17,187**

3.8.4 ENVIRONMENTAL CONSEQUENCES

Summer

A. Effects Common to All Action Alternatives

General Effects to Soils

Forest roads and trails can significantly affect site productivity by removing and displacing top-soil during initial construction, compacting subsoils, changing microclimate, and accelerating erosion. Losses of productivity associated with road-caused accelerated erosion are site-specific, and highly variable in extent (Gucinski et al. 2001). Surface erosion from road surfaces, cut banks, and ditches represent a substantial and, in some landscapes, the dominant source of road-related sediment input to streams. Rates of sediment delivery from unpaved roads are highest in the first years after building, and are closely correlated to traffic

volume. Surface-erosion problems are worst in highly erodible terrain, particularly landscapes underlain by granite or highly fractured rocks (Gucinski et al. 2001).

Poor road or trail drainage can cause runoff to pond on route surfaces. This ponding, in combination with both nonmotorized and motorized use, can degrade route surfaces over time and lead to increased erosion. Poor drainage can accelerate flow of water on route surfaces which can lead to rutting and transport of sediments off of road surfaces. Sedimentation of streams can occur when routes are located in close proximity to streams.

Soil impacts tend to be more severe at high elevations on steep slopes, and on wet, poorly drained soils. Erosion resulting from soil compaction, and other adverse impacts such as trail widening or multiple trails due to off-road vehicles, is generally greater in wetter soils, especially if subjected to heavy use.

Sensitive soils erode readily when exposed to flowing water, and are susceptible to degradation from wheel churn on motorized vehicles. Unauthorized routes on these soils, that was not properly engineered or constructed, may form ruts and widen over time, especially on slopes. Rutting on hill slopes channelizes water which further increases erosion. Typically when these erosive routes are identified on the Forest they are closed to access {Project File document SOILS-002.pdf}. There have been cases where trails were improved and maintained or were re-routed around erosive soils and slopes to provide access to a desired location.

The prohibition of motorized wheeled access for dispersed camping within 30 feet of any flowing stream, pond, lake, marsh, or wetland would reduce potential impacts to hydric soils.

Geomorphic effects of roads range from chronic and long-term contributions of fine sediment into streams to catastrophic mass failures of road cuts and fills during large storms (Gucinski et al. 2001). Roads affect geomorphic processes by four primary mechanisms: accelerating erosion from the road surface and prism itself by both mass and surface erosion processes, directly affecting channel structure and geometry, altering surface flow paths, and causing interactions among water, sediment, and woody debris at engineered road-stream crossings (Gucinski et al. 2001). Road-related mass failure results from various causes.

Maintenance is necessary to ensure the integrity of travel routes; a lack of maintenance in some locations can lead to rutting and loss of surfacing, if present, and increased erosion and sedimentation (Seyedbagheri 1996; Swift 1984; Foltz and Burroughs 1990). Erosion of problematic roads will continue which requires continual maintenance if the routes are intended to remain open for use. Maintenance of roads includes blading surfaces and ensuring drainages are clear of obstruction. Trail maintenance includes clearing the route of obstructions and implementing measures to minimize erosion. Maintenance of travel routes is based primarily on Forest Service funding. In some cases, maintenance of trail systems by volunteers occurs but is not guaranteed on an annual basis. Since FY 2010, approximately 20 percent of the open roads in the analysis area have received maintenance or are surveyed for maintenance needs on an annual basis, but this is subject to funding fluctuations. In areas where degraded road or trail conditions exist, continued loss of soil productivity could occur due to erosion and rerouting of trails by users.

Erosion of trails along ridgetops is generally a minimal concern primarily due to the gentle grade in these locations. Rutting and puddling are more likely to occur on ridgetops than offsite transport of sediment. These trail maintenance issues in addition to erosion issues on trails with steeper grades would be addressed through general trail maintenance activities, BMP upgrades, or potential relocation efforts to avoid problem sites.

B. Direct and Indirect Effects

Direct and indirect effects for this soils analysis focuses on the following indicators.

- Miles of new motorized route construction that would result in loss of soil productivity by alternative.

- Ø Potential impacts to sensitive soils from motorized wheeled access to dispersed campsites by alternative.
- Ø Comparison among alternatives regarding open motorized routes on high erosion potential soils by alternative.

Loss of Soil Productivity by Construction of Proposed New Routes

In general, the existing Forest Transportation System has been fully developed to provide essential motorized access for recreation and management of the Forest. However, there are up to eleven connector routes that are proposed as part of the Travel Management Planning Project that would improve motorized access or recreation opportunities. Table 3.8-3 compares the miles of motorized routes that require new construction for each alternative. Acres of soil productivity lost due to route construction have been estimated based upon a 20 foot wide prism. Analysis is included in {Project File document SOILS-006.pdf}.

Table 3.8- 3: Comparison of Soil Productivity Loss by Alternative

	Alt. 1	Alt. 2	Alt. 3	Alt. 4
Number of New Motorized Routes for Highway Legal Vehicles	1	0	1	1
Number of New Motorized Routes Open Seasonally to Vehicles Less than 50 inches in width	8	0	10	0
Miles of New Construction	10.4	0	10.4	0.4
Acres of Soil Productivity Lost	24.3	0	24.5	1

Alternative 1 proposes approximately 10.4 miles of new construction, which equates to a loss of nearly 25 acres of soil productivity, compared to **Alternative 2**.

Alternative 2 proposes no new construction, so there would be no loss in acres of soil productivity.

Alternatives 3 proposes approximately 10.4 miles of new construction, which equates to a loss of nearly 25 acres soil productivity compared to **Alternative 2**.

Alternatives 4 proposes approximately 0.4 miles, which equates to about a 1 acre loss in soil productivity, compared to **Alternative 2**.

Alternatives 1 and 3 have the highest amount of proposed new construction at approximately 10.4 miles, which equates to nearly 25 acres of lost soil productivity. **Alternative 4** would result in a loss of approximately 1 acre. Construction of a 0.4 mile road open yearlong to highway legal vehicles is proposed for **Alternatives 1, 3, and 4**. **Alternatives 1 and 3** also propose to construct motorized trails open seasonally to vehicles less than 50 inches in width (8 routes totaling 9.6 miles for **Alternative 1** and 10 routes totaling 9.7 miles for **Alternative 3**). Effects of the route construction will be analyzed and be available for public comment through separate NEPA analysis prior to any construction.

Overall, minimal new construction is proposed as part of the Travel Management Planning Project. Loss of soil productivity from new construction would be negligible considering the size of the existing transportation system and the overall Bitterroot National Forest's land base. New construction in **Alternatives 1 and 3** would increase the Forest's Transportation System by less than 0.04 percent; increase for **Alternative 4** would be negligible.

A number of the proposed routes were reviewed by the ID Team's Soil Scientist to determine if they should be included in the Forest's Transportation System {Project File document SOILS-004.pdf}. Initial review of these proposed route locations indicated they would be suitable due to stable trail tread and slope gradient. However, development of these routes would not occur until further review, which will require separate NEPA analyses and decisions.

Impacts to Sensitive Soils from Motorized Access to Dispersed Camping Sites

Motorized wheeled access for dispersed camping would be allowed in "corridors" off both sides of the center line of designated roads and trails where resource conditions would permit such use without causing unacceptable levels of damage. The width of the corridor will vary by alternative. Corridors would be extended to those sites identified on the maps of the alternatives. Existing dispersed sites beyond the proposed corridors that are not mapped would still be available for use; however, these campsites would need to be accessed on foot or by other nonmotorized means.

Motorized wheeled access to dispersed campsites is proposed within a 600 foot corridor (300 feet from the centerline of both sides of a designated route) for **Alternatives 1, 2, and 3**, and within a 300 foot corridor (150 feet from the centerline of both sides of designated route) for **Alternative 4**. Corridors would be extended to those sites located greater than 300 feet from the centerline of a designated route identified on the maps for **Alternatives 1, 2, and 3**, and also greater than 150 feet from the centerline of a designated route for **Alternative 4** {Project File folder 'dispersed camping,' Project File document DISP-001.pdf}.

Motorized vehicle use off of designated roads and trails can degrade soil productivity. Direct mechanical impacts can lead to soil displacement and compaction (Meyer 2002). Indirect impacts include hydrologic modifications such as the disruption of surface water flow, reduction in infiltration, surface ponding, and the loss of water-holding capacity (Meyer 2002). Unauthorized routes have the potential to accelerate erosion and sediment delivered to streams due to lack of design and poor location. These soil impacts may occur while accessing dispersed campsites with motorized vehicles. Sensitive soils, particularly hydric soils, described in Section 3.8.3 C, are of greatest concern for disturbances from motorized impacts.

Soil disturbance associated with motorized wheeled access for dispersed camping includes compaction and displacement of organic soil horizons in the motorized access path to the site. A two-track access path is common for many dispersed sites. Soils may become compacted in the wheel tracks depending on amount of use. If heavily used, the organic horizons will be displaced and vegetation will be removed. The greatest effects to soils associated with dispersed camping are where vehicles make multiple passes on the access path to the site. Dispersed sites used only several times a year may have little-to-no impacts to soils. However, there are soils that are sensitive to motorized impacts from as little as one pass to a dispersed campsite.

Motorized routes accessing dispersed campsites that cross sensitive soils may cause excessive disturbance depending on vegetation, ground cover, topography, and coarse fragment content. Motorized access routes to dispersed campsites that have resulted in excessive soil disturbance have been closed in the past {Project File document SOILS-002.pdf}. The Forest will continue to monitor the emergence of new dispersed camping sites that are accessed by motorized vehicles, as well as changes at existing sites. The Forest will alter or close sites where motorized access routes result in excessive disturbance to sensitive soils.

Several factors suggest a range of minor-to-moderate future increases in motorized wheeled access for dispersed camping and associated effects to soils. Most sites that have desirable campsite characteristics have already been established by repeated use, limiting future increases in the number of motorized routes to access them. Expansion of new and existing sites is expected, but would likely be limited by terrain features including standing and down trees, large rocks, thick vegetation, water features, narrow stream canyons, and abrupt topographic changes. Existing dispersed sites typically have a suitable motorized access route commonly used to get to the site.

The Forest has a continuing program of installing barriers to limit vehicle access or gravelling defined access routes where needed to reduce streamside impacts.

Motorized access trails to dispersed sites are often on gentle-to-moderate slopes (less than 30 percent gradient). Motorized access trails on steeper gradients often lead to erosion and excessive soil disturbance; these are commonly closed to motorized access. Motorized access trails to dispersed campsites must limit soil disturbances that cause erosion, threaten wildlife habitat, harm forest riparian areas, or damage forest administrative sites. Project design features specific to the soil resource have been incorporated into this project. Please refer to Chapter 2, Table 2-19. In addition, dispersed campers are not permitted to remove trees, boulders, logs, stumps, or other natural features that block motorized access to a desired camp site.

The Bitterroot National Forest is engaged in an active watershed improvement program that includes restricting access and rehabilitating motorized access trails where excessive soil productivity is lost and erosion occurs. Access is restricted through the placement of large rocks/boulders, dropping trees, and constructing Kelly humps. Rehabilitation is achieved through decompaction and recontouring, followed by seeding, fertilizing, mulching, and slash placement. Motorized access routes that threaten water, fisheries, wildlife, and botany resources are also commonly closed to prevent further impacts to resources {Project File document SOILS-002.pdf}.

Table 3.8-4 displays the difference in acres of sensitive soils that are located within the 600 foot corridor (300 feet from the centerline of both sides of a designated route) for **Alternatives 1 and 3**, and within the 300 foot corridor (150 feet from the centerline of both sides of a designated route) for **Alternative 4** as compared to the existing condition, **Alternative 2** (600 foot corridor). These areas were identified by overlaying sensitive soil data on slopes less than 30 percent gradient within the corridors for each alternative. The values for **Alternative 2** are shown as zero since the analysis shows the direct comparison of **Alternatives 1, 3, and 4** with **Alternative 2**. Analysis is included in {Project File document SOILS-006.pd}.

Table 3.8- 4: Change in Acres of Sensitive Soils Located within Motorized Access Corridors for Dispersed Camping by Alternative

Sensitive Soils (acres)	Alt. 1	Alt. 2	Alt. 3	Alt. 4
Soils with high erosion potential	-332	0	297	-4,811
Ash cap soils	-1,200	0	661	-5,995
Hydric soils	-28	0	0	-113
Landslide/slump prone soils	-73	0	99	-1138
Change in Acres	**-1,633**	**0**	**1,057**	**-12,057**

Table 3.8-5 shows the total acres of sensitive soils within the motorized access corridors:

Table 3.8- 5: Acres of Sensitive Soils Located within Motorized Access Corridors for Dispersed Camping by Alternative

Sensitive Soils (acres)	Alt. 1	Alt. 2	Alt. 3	Alt. 4
Soils with high erosion potential	6,421	6,753	7,050	1,942

Sensitive Soils (acres)	Alt. 1	Alt. 2	Alt. 3	Alt. 4
Ash cap soils	7,200	8,400	9,061	2,405
Hydric soils	111	139	139	26
Landslide/slump prone soils	1,822	1,895	1,994	757
Total Acres of Sensitive Soils[1]	**15,554**	**17,187**	**18,244**	**5,130**

[1] The table displays the maximum amount of sensitive soil acres located within the motorized wheeled access corridors for dispersed camping; the analysis provides a "worst-case" scenario comparison among alternatives in regards to sensitive soils. Realistically, not all of these sensitive soil acres would be accessible by motorized vehicles, since terrain features within the corridors, including standing and down trees, large rocks, thick vegetation, water features, narrow canyons, and abrupt topographic changes, block motorized access. Existing dispersed sites typically have a suitable motorized access route commonly used to get to the site. The Forest will continue to monitor the emergence of new dispersed camping sites that are accessed by motorized vehicles, as well as the changes at existing sites. The Forest will alter or close sites where motorized access routes result in excessive disturbance to sensitive soils {Project File document SOILS-002.pdf}.

Alternative 1 would result in an approximate 1,633 acre decrease in the acres of sensitive soils that may be disturbed within motorized wheeled access corridors for dispersed camping when compared with **Alternative 2.**

Alternative 2 would not change the acres of sensitive soils that may be disturbed within a 600 foot corridor (300 feet from the center of both sides of a designated route.) Motorized wheeled access for dispersed camping would not be prohibited within 30 feet of any flowing stream, pond, marsh, or wetland, which could lead to further impacts to hydric soils.

Alternative 3 would result in an approximate 1,057 increase in the acres of sensitive soils present within motorized wheeled access corridors for dispersed camping, compared to **Alternative 2**.

Alternative 4 would result in an approximate 12,057 acre decrease in the acres of sensitive soils within motorized wheeled access corridors for dispersed camping, compared to **Alternative 2**.

The alternatives were compared to the existing condition (**Alternative 2**) to provide context concerning potential differences in the amount of sensitive soils located within the proposed motorized corridors for dispersed camping access. This comparison is based on the total amount of sensitive soil acres that exist within the motorized wheeled access corridors for dispersed camping.

Alternative 1 would decrease the potential amount of sensitive soils that may be disturbed by motorized access to dispersed campsites when compared with **Alternative 2**. **Alternative 2** would result in the second highest total acres of sensitive soils that may be disturbed by motorized access. **Alternative 3** has the greatest amount of sensitive soils present within the motorized corridors for dispersed camping, which increases the likelihood of disturbing the highest amount of sensitive soils when compared to other alternatives, including **Alternative 2**. **Alternative 4** has the least amount of sensitive soils available within the motorized access corridor, which would lead to the least amount of disturbance to sensitive soils when compared with all alternatives, including **Alternative 2**.

Routes on Soils Sensitive to Erosion

Comparison of action alternatives to **Alternative 2** has been completed to identify which alternatives may have higher risk to create erosion on routes open to motorized travel (Table 3.8-4). Currently, 107 miles of routes exist on high erosion potential soils and are open to motorized use (**Alternative 2**). Motorized use on these routes has the potential to increase erosion, which may affect watershed and fishery resources in locations where eroded sediments are capable of reaching streams. Analysis is included in {Project File document SOILS-005.pd}.

Table 3.8- 6: Miles of Routes to Remain Open to Motorized Vehicles on Soils with High Erosion Potential

	Alt. 1	Alt. 2	Alt. 3	Alt. 4
Miles of Routes on Soils with High Erosion Potential	101	107	113	56

Alternative 1 would reduce the miles of open motorized routes on high erosion potential soils by 6 miles to 101 miles, compared to **Alternative 2**. This would lessen sedimentation issues that occur from vehicle disturbances. Closed motorized routes would still remain on the Forest's Transportation System, but would be used only for administrative purposes and would be closed to public motorized travel

Alternative 2 would not affect the miles of open motorized routes on high erosion potential soils.

Alternative 3 would increase the miles of routes open to motorized travel on soils with high erosion potential; an additional 6 miles of routes would be opened to motorized travel on high erosion soils when compared with the current 107 miles currently open in **Alternative 2.** The 6 miles of routes proposed to be opened in **Alternative 3** to motorized access currently exist on the Forest's Transportation System; however, they are presently closed to motorized access.

Alternative 4 would reduce the amount of open motorized routes on high erosion potential soils by 51 miles compared with **Alternative 2**. This would lessen sedimentation issues that occur from vehicle disturbances. Closed motorized routes would still remain on the Forest's Transportation System, but would be used only for administrative purposes and would be closed to public motorized travel

Closing a route to public motorized access is effective at reducing erosion and sediment potential due to an overall reduction in use of the road. In order to fully eliminate erosion and sedimentation issues from road systems, rehabilitation efforts such as decompaction, recontouring, seeding, fertilizing, and/or slashing with debris would be necessary. Obliteration and rehabilitation of motorized routes would return these areas back to the productive land base and would result in an improvement in soil quality. Road rehabilitation treatments are not proposed as part of this travel management process. Any road obliteration and rehabilitation would be would be analyzed in future NEPA projects, and would be available for public comment at that time.

Direct and Indirect Effects by Alternative

Alternative 1

Alternative 1 includes a total of 2,293 miles of motorized routes. **Alternative 1** proposes to leave 101 miles of routes open to motorized travel on high erosion potential soils, approximately 6 miles less than **Alternative 2**.

Loss of soil productivity would occur on 24.3 acres in **Alternative 1** due to the construction of 10 miles of new motorized routes. These proposed new routes would create new motorized loop opportunities. A number of these routes were reviewed by the Soil Scientist to determine if they should be included in the Forest's Transportation System {Project File document SOILS-004.pdf}. Initial review of these proposed motorized routes indicated they would be suitable due to stable trail tread and slope gradient. Construction of these new routes would not occur until further review and effects analysis is completed in future NEPA decisions.

Similar to **Alternatives 2 and 3**, the motorized wheeled access corridor for dispersed camping would be limited to 300 feet on either side of a designated route in **Alternative 1**; the corridor would be extended to those sites identified on the maps of the alternatives. A total of 15,554 acres of sensitive soils on slopes less than 30 percent are located within the 600 foot corridor for **Alternative 1**. This represents a 1,633 acre

decrease (9.5 percent) from **Alternative 2** (Existing Condition). Not all of these sensitive soil acres would be impacted by future motorized access.

Several factors suggest a range of minor-to-moderate future increases in motorized wheeled access for dispersed camping and associated effects to soils. Most sites that have desirable campsite characteristics have already been established by repeated use, limiting future increases in the number of motorized routes to access them. Expansion of new and existing sites is expected, but would likely be limited by terrain features including standing and down trees, large rocks, thick vegetation, water features, narrow stream canyons, and abrupt topographic changes. Existing dispersed sites typically have a suitable motorized access route commonly used to get to the site. The Forest has a continuing program of installing barriers to limit vehicle access or gravelling defined access routes where needed to reduce streamside impacts. The Forest will continue to monitor the emergence of new dispersed camping sites that are accessed by motorized vehicles, as well as changes at existing sites. Sites where motorized access routes result in excessive effects to fish and aquatic habitat will be altered or closed.

The total number of sites used for dispersed camping, and associated motorized routes, is expected to increase gradually over time. Firewood cutting following beetle or fire events is expected to open up more access routes to dispersed camp sites.

Alternative 1 proposes to designate about 30 miles of unauthorized routes on the MVUM. About 18 miles would be proposed to be designated as ATV trails seasonally; approximately 1 mile would be designated to be open yearlong. Some of these routes would connect existing roads.

Approximately 10 miles of these routes proposed to be designated for ATVs would not be shown on the MVUM until separate site-specific NEPA analysis and decisions, associated with relocating the routes to more sustainable locations to address erosion concerns, are completed and they exist on the ground.

Additionally, 11 miles of unauthorized routes would be proposed to be designated for use as motorcycle trails: 10 miles would be open seasonally, and 1 mile would be open yearlong {Project File folder 'unauthorized_trails,' Project File document UAT-003.pdf}.

Once unauthorized routes are designated, the Forest Service would be able to expend funds on them for maintenance and improvement, which are intended to ensure the integrity of travel routes. Consequently, conditions on the routes would improve, as ruts would be bladed, reducing erosion and sedimentation.

For a listing of the unauthorized routes proposed to be designated on the MVUM in **Alternative 1**, please refer to Appendix K to the FEIS.

Alternative 2 - No Action

The existing effects associated with soils are described in Section 3.8.3 (Affected Environment).

Alternative 2 (No Action) includes a total of 2,601 miles of motorized routes. **Alternative 2** would maintain the current condition of soil resources. The existing motorized access for roads and trails would continue. No closed routes would be opened to motorized use with this alternative.

Approximately 107 miles currently exist on high erosion potential soils.

Construction of new motorized routes would not occur in **Alternative 2**.

Dispersed motorized camping would be permitted within 300 feet of either side of a designated route. A total of 17,187 acres of sensitive soils on slopes less than 30 percent are located within the 600 foot corridor for **Alternative 2**.

Alternative 2 would not designate any authorized routes on the MVUM. Consequently, the Forest Service would not be able to expend funds to maintain or improve unauthorized routes; maintenance and improvements are necessary to address accelerating erosion and sediment delivery. Conditions on the

routes would continue to deteriorate, as erosion would create deeper ruts, leading to increased sedimentation.

Alternative 3

Alternative 3 includes a total of 2,683 miles of motorized routes. **Alternative 3** proposes 113 miles of motorized routes on high erosion potential soils, approximately 6 miles more than **Alternative 2**. The 6 miles of routes proposed to be opened to motorized access currently exist as closed routes on the Forest's Transportation System.

Loss of soil productivity would occur on 24.5 acres in **Alternative 3** due to the construction of 10.1 miles of new motorized routes. These proposed new routes would create new loop opportunities. Similar to **Alternatives 1 and 2**, the motorized wheeled access corridor for dispersed camping would be limited to 300 feet on either side of a designated route in **Alternative 3**; the corridor would be extended to those sites identified on the maps of the alternatives. A total of 18,244 acres of sensitive soils on slopes less than 30 percent are located within the 600 foot corridor for **Alternative 3**. This represents an increase of approximately 1,057 acres (6.1 percent) compared to **Alternative 2**. Not all of these sensitive soil acres would be impacted by future motorized access. Several factors suggest a range of minor-to-moderate future increases in motorized wheeled access for dispersed camping and associated effects to soils. Most sites that have desirable campsite characteristics have already been established by repeated use, limiting future increases in the number of motorized routes to access them. Expansion of new and existing sites is expected, but would likely be limited by terrain features including standing and down trees, large rocks, thick vegetation, water features, narrow stream canyons, and abrupt topographic changes. Existing dispersed sites typically have a suitable motorized access route commonly used to get to the site. The Forest has a continuing program of installing barriers to limit vehicle access or gravelling defined access routes where needed to reduce streamside impacts. The Forest will continue to monitor the emergence of new dispersed camping sites that are accessed by motorized vehicles, as well as changes at existing sites. Sites where motorized access routes result in excessive effects to fish and aquatic habitat will be altered or closed.

The total number of sites used for dispersed camping, and associated motorized routes, is expected to increase gradually over time. Firewood cutting following beetle or fire events is expected to open up more access routes to dispersed camp sites.

Alternative 3 would have more new construction and open motorized routes compared to **Alternative 2**.

Alternative 3 proposes to designate 35 miles of unauthorized routes on the MVUM. About 19 miles would be proposed to be designated as ATV trails seasonally; approximately 1 mile would be designated to be open yearlong. Some of these r**o**utes would connect existing roads.

About 10 miles of the routes proposed to be designated for ATVs would not be shown on the MVUM until separate site-specific NEPA analysis and decisions, associated with relocating the routes to more sustainable locations to address rutting and erosion concerns, are completed and they exist on the ground.

Under **Alternative 3**, 14 miles of unauthorized routes would be proposed to be designated seasonally for use by motorcycles, and 1 mile would be designated for yearlong use{Project File folder 'unauthorized_trails,' Project File document UAT-004.pdf}.

Once unauthorized routes are designated, the Forest Service would be able to expend funds on them for maintenance and improvement, which are intended to ensure the integrity of travel routes. Consequently, conditions on the routes would improve, as ruts would be bladed, reducing erosion and sedimentation.

For a listing of the unauthorized routes proposed to be designated on the MVUM in **Alternative 3**, please refer to Appendix K to the FEIS.

Alternative 4

Alternative 4 includes a total of 1,223 miles of motorized routes. **Alternative 4** proposes to leave open only 56 miles of motorized routes on high erosion potential soils, approximately 51 miles less than **Alternative 2**.

Loss of soil productivity would occur on 1 acre due to the construction of a 0.4 mile road open yearlong to highway legal vehicles. Construction of this new route would not occur until further review and effects analysis is completed in a future NEPA decision.

The motorized wheeled access corridor for dispersed camping would be limited to 150 feet on either side of a designated route in **Alternative 4**; the corridor would be extended to those sites identified on the maps of the alternatives. A total of 5,131 acres of sensitive soils on slopes less than 30 percent are located within the 300 foot corridor for **Alternative 4**. This represents a decrease of approximately 12,057 acres (70 percent) from **Alternative 2**. The analysis provides a worst-case scenario comparison among alternatives in regards to sensitive soils.

Several factors suggest a range of minor-to-moderate future increases in motorized wheeled access for dispersed camping and associated effects to soils. Most sites that have desirable campsite characteristics have already been established by repeated use, limiting future increases in the number of motorized routes to access them. Expansion of new and existing sites is expected, but would likely be limited by terrain features including standing and down trees, large rocks, thick vegetation, water features, narrow stream canyons, and abrupt topographic changes. Existing dispersed sites typically have a suitable motorized access route commonly used to get to the site. The Forest has a continuing program of installing barriers to limit vehicle access or gravelling defined access routes where needed to reduce streamside impacts. The Forest will continue to monitor the emergence of new dispersed camping sites that are accessed by motorized vehicles, as well as changes at existing sites. Sites where motorized access routes result in excessive effects to fish and aquatic habitat will be altered or closed.

The total number of sites used for dispersed camping, and associated motorized routes, is expected to increase gradually over time. Firewood cutting following beetle or fire events is expected to open up more access routes to dispersed camp sites.

Many of the locations where motorized access to desirable dispersed camping areas could be created by the public have been established by repeated use. Additionally, not all areas within the corridors will be accessible by motorized vehicles due to the presence of natural barriers, including abrupt topographic features, large rocks, water features, narrow stream canyons, standing and down trees, and thick vegetation.

Alternative 4 would reduce motorized access for dispersed camping, which would reduce the cumulative effects of past motorized use and reduce the potential for soil erosion and loss of soil productivity.

Alternative 4 proposes to designate 3 miles of unauthorized routes on the MVUM. About 2 miles would be proposed to be designated as ATV trails seasonally; approximately 1 mile would be designated to be open yearlong. Several of these routes would connect existing roads.

No unauthorized trails for motorcycles would be proposed for designation in **Alternative 4**. All of the routes would be shown on the MVUM as no separate site-specific NEPA analysis would be required {Project File folder ‘unauthorized_trails,’ Project File document UAT-005.pdf}.

Once unauthorized routes are designated, the Forest Service would be able to expend funds for maintenance and improvement, which are intended to ensure the integrity of travel routes. Consequently, conditions on the routes would improve, as ruts would be bladed, reducing erosion and sedimentation.

For a listing of the unauthorized routes proposed to be designated on the MVUM in **Alternative 4**, please refer to Appendix K to the FEIS.

Over-Snow

Over-snow vehicle use seldom disturbs soils or causes loss of ground cover due to the layer of snow separating the machine from the ground. Occasionally, over-snow vehicle use will occur on ridges blown free of snow, where no other path is feasible. These areas tend to be extremely minor, and frozen conditions provide protection from compaction and displacement of soils. For these reasons, no effects to soils are attributed to over-snow vehicle use, and they will not be discussed further as a soil resource effect. There would be no difference between alternatives for over-snow vehicle use and soil effects.

Summary

Alternative 4 would have the least impact on the Soils resource, followed by **Alternative 1, Alternative 2, and Alternative 3**. The biggest difference between the alternatives would be the acres of sensitive soils with the potential to be disturbed in corridors used for motorized wheeled access for dispersed camping. Use of motorized vehicles off of designated routes which cross sensitive soils to access dispersed camp sites can degrade soil productivity, and cause rutting as well as displacement and compaction. The acres of sensitive soils located within motorized access corridors for dispersed camping are as follows: **Alternative 3 (**18,244 acres); **Alternative 2 (**17,187 acres); **Alternative 1 (**15,554 acres), and **Alternative 4** (5,130 acres).

Forest roads and trails can also affect site productivity by removing and displacing top-soil during initial construction, compacting subsoils and changing the microclimate. This can result in the reduction or loss of rooting capacity, water infiltration, and microbiological activity, and the ponding of water, surface runoff, and accelerating erosion. However, minimal new construction is proposed as part of the Travel Management Planning Project: **Alternative 1** proposes approximately 10.4 miles of new construction, which equates to a loss of nearly 25 acres of soil productivity; **Alternative 2** proposes no new construction, so there would be no loss of soil productivity; **Alternatives 3** proposes approximately 10.4 miles of new construction, which equates to a loss of nearly 25 acres soil productivity, and **Alternative 4** proposes approximately 0.4 miles, which equates to about a 1 acre loss in soil productivity. Loss of soil productivity from new construction would be negligible considering the size of the existing transportation system and the overall Bitterroot National Forest's land base.

Motorized routes on soils sensitive to erosion have the potential to increase erosion, which may affect water resources and fisheries in those locations where eroded sediments are capable of reaching streams. **Alternative 3** contains 113 miles of routes on soils with high erosion potential, followed by **Alternative 2** (107 miles), **Alternative 1** (101 miles), and **Alternative 4** (56 miles). **Alternative 4** would result in the largest reduction in miles of routes open to motorized travel on soils with high erosion potential, followed by **Alternative 1**. **Alternative 3** would result in an increase in motorized routes located on high erosion potential soils. There would be no change with **Alternative 2**.

The direct and indirect effects to soils from National Forest System roads and trails are expected to continue. Unauthorized routes created by motorized users will continue to disturb soil resources. Effects of these routes on the soil resource are similar to those of primitive two-track roads. The Forest will continue to monitor unauthorized motorized routes, and will close and rehabilitate these disturbances as they are identified {Project File document SOILS-002.pdf}.

C. Cumulative Effects

Geographic Boundaries

The defined cumulative effects analysis area for soils is the same as the project area; the portion of the Bitterroot National Forest outside of Designated Wilderness. This analysis area is appropriate to analyze any incremental effects from the actions of this project, in combination with past, present, and reasonably foreseeable activities, because effects of implementing travel planning decisions on the Bitterroot National Forest would be negligible to soils outside this analysis area.

Activities Within the Cumulative Effects Analysis Area

Past actions have contributed to the existing condition for the Soils resource, which is described in Section 3.8.3 (Affected Environment). The construction of National Forest System roads and trails, associated primarily with timber harvest projects, and activities associated with timber harvest, have resulted in adverse effects to the Soils resource which are ongoing.

Appendix A to the FEIS describes past, present, and reasonably foreseeable forest and other activities, which, when combined with the activities proposed in the Travel Management Planning Project, could result in disturbance and sediment production, contributing to cumulative effects to soils. The Worksheet for Consideration of Cumulative Effects to the Soil Resource has been completed and is included as {Project File document SOILS-003.pdf}.

There are activities that occur on the Forest that may or may not have detrimental cumulative effects on soils. In order to determine cumulative effects on soils, it is necessary to understand how they can be impacted. Soil resource cumulative effects focus on soil productivity. Water yield and sediment influences can also be affected, and lead to effects on other resources such as streams. Water yield is not a concern with the activities proposed in the Travel Management Planning Project. Discussion of sediment influences is included in Chapter 3, Water Resources, and Fish and Aquatic Habitat, Sections 3.6 and 3.7 of this FEIS, respectively. Loss of soil productivity from various activities is the greatest concern for both direct and cumulative effects to soils.

Summer

Some forest activities have a negligible effect on soils. Their potential for disturbance, compaction, displacement, erosion, or loss of productivity is negligible for the following reasons:

- Ø The activity's disturbance is too small, is a one-time occurrence, or is too isolated to produce an effect
- Ø Ground-based equipment is not used
- Ø Project design features are applied to reduce the activity's effects to negligible levels
- Ø Environmental conditions, such as snow cover, protect soils
- Ø The time elapsed and natural recovery that has occurred since project completion has diminished effects to negligible levels

Examples of forest activities, which, when carried out consistent with existing regulations, result in negligible cumulative effects to soils includes:

- Ø Timber harvest that occurred more than 40-50 years ago
- Ø Prescribed burning that occurred more than 2 years ago
- Ø Personal use firewood cutting
- Ø Personal use Christmas Tree harvesting
- Ø Special Uses\Permits
- Ø Public Use

There are other forest activities which could result in cumulative effects to soils:

Road and Trail Management

Routine road maintenance projects include blading, gate repair/replacement, periodic upgrades of drainage structures, gravelling of surfaces and other sediment-reduction work, cleaning ditches and culverts, brushing, and debris removal. These activities are intended to reduce the time that water is on roads and trails surfaces, and to help stabilize them. This reduces sediment risk to streams, and is considered beneficial. Frozen and/or snow covered road conditions in the winter protects the road surface from degradation by motorized use.

Timber Harvest, Prescribed Burning, and Associated Activities

Soil disturbance associated with timber harvest across the Forest has been widespread and is ongoing. The disturbances usually occur as part of yarding logs, building and using skid trails, temporary roads, and landings, and slash disposal with fire. These activities expose mineral soil and have the potential to compact, displace, burn, or puddle soils (Clayton 1990; Elliot et al. 1999). Exposed soils are susceptible to erosion from runoff (Clayton 1990). Project design features and application of Soil and Water Conservation Practices (USDA Forest Service 1995) are important for minimizing impacts to soils.

Prescribed burning will also continue across much of the Forest. Prescribed fire used as a tool for managing vegetation can cause detrimental soil impacts when burn severities are too high. Severe burning can consume duff layers and cause physical damage to the surface mineral layers of soil, especially forest soils. Some plant nutrients stored in the burned material are converted to a gaseous state and lost from the site by burning. Nitrogen and sulfur are especially susceptible (Harvey et al. 1994). Fires may increase soil pH, which directly affects availability of many nutrients. Endo and ectomycorrhizae are particularly sensitive to soil heating by fire because they are concentrated in the organic and upper mineral soil layers (Keane et al. 2002). Fires can also cause formation of water repellent layers in soils that impede infiltration and can cause massive erosion (Keane et al. 2002). Project design and application of Soil and Water Conservation Practices (USDA Forest Service 1995) would minimize the detrimental impacts to soils.

Several present and reasonably foreseeable projects listed in Appendix A to the FEIS will decommission, store, or close system roads and "undetermined" status roads. In the case of some "undetermined" status roads, they may be placed on the Forest's Transportation System if the project-specific travel analysis determines they are necessary for future management. The Darby Lumber Lands Watershed Improvement and Travel Management Project will place approximately 55 miles of closed roads into long-term storage, and decommission an additional 66 miles of roads. The Three Saddle Vegetation Management project will decommission approximately 9.5 miles of road, and place about 1.1 miles of road in long-term storage. The Como Forest Health Protection Project will place approximately 3.1 miles of undetermined roads in long-term storage, and will decommission about 3.5 miles of undetermined roads. The Meadow Vapor project will be proposing to decommission and place some roads in long term storage.

Decommissioning roads or placing them in long-term storage lowers the risk of erosion and sediment reaching streams. Decommissioning roads on the Forest's Transportation System, by removing them from the landscape, would return these areas back to the productive land base, and allow for soil recovery through either active rehabilitation treatments or natural recovery.

Cattle Grazing

Soil disturbance from cattle grazing is expected to continue on allotments across the Forest. Grazing pressure is generally concentrated in valleys, meadows, and flat benches. Effects of cattle grazing on uplands are usually restricted to small concentrated areas where cattle bed, loaf under shade, water at developments, obtain salt, and trail along fence lines and driveways. Soils in high use areas can become compacted and may have increased probability for wind and water erosion due to reduced vegetative cover and increased bare ground. Grazing by cattle on riparian soils increases bare ground, increases erosion by water, ice and wind, decreases the litter layer, increases compaction, decreases infiltration, and decreases fertility (Belsky et al. 1999; Wheeler et al. 2002). Projects have recently been implemented on the Forest to fence cattle away from areas where there have been re-occurring impacts to streams that contain native fish. For additional information, please refer to the monitoring of cattle grazing summarized in annual Forest Plan Monitoring and Evaluation Reports in the section titled Riparian Area Condition, Item 22 {Project File folder 'forest plan and monitoring,' Project File documents FPMON-003.pdf to 025.pdf, and 030.pdf to 036.pdf}.

Wildfire Suppression

Fire suppression often utilizes heavy equipment to construct firelines. Fireline construction displaces and compacts soils. Firelines are treated to control erosion and ATV traffic immediately after use, but soil compaction and displaced soils may remain for several years in select areas. Rehabilitation of firelines does not often address compaction concerns. In extreme conditions (south or west-facing, steep slopes), vegetation may take many years to recover, which delays recovery of soil as well.

Activities on State and Private Lands

Activities that occur on state or private lands may reduce soil productivity on those lands, which may cumulatively reduce soil productivity in watersheds with shared U.S. Forest Service ownership. The most common activities that lead to losses in soil productivity on State and private lands include road construction, timber harvest, grazing, and property development.

Wildfires

Wildfire is expected to play an increased role across the Bitterroot National Forest due to trends of increased warming and drying. The effects of stand-replacing fire would be compounded by existing roads and trails. Roads and trails concentrate flow from upslope and deliver the concentrated flow to natural channels. During intense storms on severely burned landscapes, drainage along roads and trails may not be adequate, which can lead to blowouts where concentrated flow is directed downslope. Soils are impacted greatly by the erosive force of the concentrated water since vegetation has been lost to the fire. These potential effects are expected to be higher with a high intensity burn over a large area on moderately steep or steeper slopes and where road densities are higher.

Natural Disturbance Events

Natural disturbance events such as blowdowns, floods, and mass movement events will continue to influence soil conditions within the analysis area. Blowdowns commonly occur during high wind conditions; they cause displacement of soils and expose mineral soils to erosion depending on landscape position. Flooding can cause soil erosion and decrease productivity in heavily eroded areas or areas where sediment deposition buries productive soils. Mass movements in the form of debris torrents and debris avalanches reduce soil productivity by displacing productive soil horizons. In many cases, soils are completely to bedrock or impermeable layers. All of these natural events are expected to continue within their current range of variability.

Over-Snow

Over-snow vehicle use seldom disturbs soils or causes loss of ground cover or erosion, due to the layer of snow separating the machine from the ground. This would apply to roads, trails, and areas. There would be negligible cumulative effects to the Soil resource associated with personal use firewood cutting and Christmas Tree harvesting, over-snow vehicle use, public use, special uses\permits, and activities on state and private lands.

As many roads and trails would be snow-covered during the winter months, this would limit their use by motorized vehicles, both by the public and Forest Service personnel. Subsequently, forest activities including road and trail management and invasive plants management would not occur. Cattle typically graze on allotments on National Forest System lands between May 15 and October 31; they would not be grazing during winter months.

Timber harvest projects to be implemented during the winter months would contain sale contract language regarding operating on frozen or snow-covered ground to protect sensitive soils. There would be negligible cumulative effects to Soils.

Cumulative Effects from the Implementation of the Alternatives

Alternative 1

Most of the above listed present and reasonably foreseeable activities would have negligible cumulative effects on the Soils resource, in combination with the activities proposed in the Travel Management Planning Project. Road and trail management, and long-term storage and decommissioning of roads, would result in beneficial effects.

Alternative 2

Most of the above listed present and reasonably foreseeable activities would have negligible cumulative effects on the Soil resource, in combination with the activities proposed in the Travel Management Planning Project. Road and trail management, and long-term storage and decommissioning of roads, would result in beneficial effects.

Alternative 3

Most of the above listed present and reasonably foreseeable activities would have negligible cumulative effects on the Soil resource, in combination with the activities proposed in the Travel Management Planning Project. Road and trail management, and long-term storage and decommissioning of roads, would result in beneficial effects.

Alternative 4

Most of the above listed present and reasonably foreseeable activities would have negligible cumulative effects on the Soil resource, in combination with the activities proposed in the Travel Management Planning Project. Road and trail management, and long-term storage and decommissioning of roads, would result in beneficial effects.

Cumulative Effects Finding

There will be negligible cumulative effects to soils from past, present, and reasonably foreseeable activities including road management, timber harvest and associated activities, cattle grazing, wildfire suppression, and activities on State and private lands, in combination with the activities proposed in **Alternatives 1, 2, 3, and 4**. However, implementation of **Alternatives 1, 2, 3, and 4** would not lead to large cumulative increases in detrimental soil conditions since impacts to soil productivity occurred when forest routes were initially constructed.

In general, cumulative effects of the Travel Management Planning Project on soils would be greatest for **Alternative 3**, while **Alternative 4** would have the least effect on soils. **Alternative 1** would reduce cumulative effects to soils slightly less than **Alternative 2**, No Action.

Alternatives 1 and 4 would cumulatively reduce the amount of sensitive soils present in motorized wheeled access corridors for dispersed camping sites when compared to **Alternatives 2 and 3**. This reduction is due to a decrease in the overall amount of open motorized routes for **Alternatives 1 and 4**.

Erosion is expected to persist on motorized routes located on high erosion potential soils. **Alternative 4** will reduce the number of open motorized routes on high erosion potential soils by nearly half when compared to the other alternatives.

It should be noted that implementing **Alternatives 1, 3, and 4** would reduce the cumulative effects of past activities because many unauthorized routes would no longer be available, and the potential for erosion and loss of soil productivity would be reduced.

Furthermore, the inclusion of the design features listed in Table 2-19, in Chapter 2 of this FEIS, including Soil and Water Conservation Practices, and adhering to Region 1 Soil Quality Standards, in the proposed

activities, as well as in Present and Reasonably Foreseeable Activities, will result in a reduction in adverse impacts to soils.

3.8.5 CONSISTENCY WITH THE FOREST PLAN, LAWS, AND REGULATIONS

The Travel Management Planning Project is essentially a planning effort, and does not create new ground disturbance. As such, consistency with existing regulation is a matter of incorporating various concerns into the planning effort. This has been done in all phases of the project.

A. Bitterroot National Forest Plan

Consistency with the Bitterroot National Forest Plan forest-wide resource and management area standards applicable to the soil resource would be accomplished the following ways. The Bitterroot National Forest Plan does not have numeric soil quality standards.

Forest-wide Management Standards:

Soil and Water Conservation Practices will be a part of project design and implementation to ensure soil and water resource protection (USDA Forest Service 1987a, II-25).

How addressed:

Region 1 Soil and Water Conservation Practices applicable to travel management planning were included in the table of Project Design Features (Table 2-19) in Chapter 2 of the FEIS.

Plan and conduct land management activities so that reductions of soil productivity potentially caused by detrimental compaction, displacement, puddling, and severe burning are minimized (USDA Forest Service 1987a, II-25).

How addressed:

Hydrology, Soils, and Fisheries specialists worked with the Interdisciplinary Team (FEIS Appendix D- List of Preparers) to minimize impacts to soil and watershed values. A soil scientist field reviewed existing site conditions on system routes and unauthorized routes with potential soil concerns in all alternatives{Project File document SOILS-004.pdf} and {Project File folder 'field_review_notes_soils,' Project File document FR-NOTES-SOILS-001.pdf}. Utilizing this data, the soil scientist was able to determine necessary closures or modifications of routes to protect soil productivity.

Plan and conduct land management activities so that soil loss, accelerated surface erosion, and mass wasting, caused by these activities, will not result in an unacceptable reduction in soil productivity and water quality (USDA Forest Service 1987a, II-25).

How addressed:

See above discussion under Page II-25(7).

Design or modify all management practices as necessary to protect land productivity and maintain land stability (USDA Forest Service 1987a, II-25).

How addressed:

See above discussion under Page II-25(7).

Meeting Forest Plan direction with the No Action Alternative or the action alternatives based on current and projected levels of maintenance funding may be problematic in the future and may require further refinement of system routes.

Management Area Standards:

Management Areas 1, 2, 3a, 3b, 3c, 5, 8a, and 8b (USDA Forest Service 1987a, III-6, 12, 18, 27, 33, 40, 59, and 62).

Provide soils technical support for management activities on sensitive soils

How addressed:

A Soil Scientist participated on the Travel Management Planning Project ID Team (FEIS Appendix D – List of Preparers), and will participate in the implementation as needed.

All alternatives would be in compliance with applicable forest-wide and management area Forest Plan standards.

Executive Order 11644 (1972), as amended by 11989 (1977) addressed OHV use on public lands. The order establish direction for the management of OHV use, and provides for closing areas to OHVs where resources would, or are, being negatively impacted.

How addressed:

The Bitterroot National Forest is engaged in an active watershed improvement program that includes restricting access and rehabilitating motorized access trails where excessive soil productivity is lost and erosion occurs. Motorized access routes that threaten water, fisheries, wildlife, and botany resources are also commonly closed to prevent further impacts to resources {Project File document SOILS-002.pdf}.

Region 1 Soil Quality Standards (R1 SQS) were developed to meet direction in the National Forest Management Act of 1976 and other legal mandates. To manage National Forest System lands under ecosystem management principles without permanent impairment of land productivity and to maintain or improve soil quality.

How addressed:

Soil quality standards apply to lands where vegetation and water resource management are the principal objectives, that is, timber harvest, grazing pastures or allotments, wildlife habitat, and riparian areas. The standards do not apply to intensively-developed sites such as mines, developed recreation sites, administrative sites, or rock quarries. They are not intended to prohibit other resource management practices such as installing waterbars or preparing sites for planting, as long as such practices are consistent with long-term sustainability of the soil resource. Permanent roads do affect soil-hydrologic function, however, their evaluation is more appropriately done on a watershed basis using models and other watershed analysis techniques.

All alternatives would be in compliance with Executive Order 11644, as amended by E.O. 11989, and Region 1 soil quality standards.

3.8.6 CHANGES BETWEEN DRAFT EIS AND FINAL EIS

- Minor grammatical edits were made to correct typographical errors and improve readability
- Section 3.8 (Soils) was rewritten to improve clarity and organization
- Section 3.8.1 (Scope of Analysis and Analysis Methods) was rewritten to describe the change in the measurement indicators. The indicators were changed in response to comments on the DEIS.
- Section 3.8.2 (Regulatory Framework) was rewritten to improve clarity
- Section 3.8.3 (Affected Environment) was rewritten to improve clarity and organization. Revisions to Tables 3.8-1 and 3.8-2; Table 3.8-1 now shows the miles of high erosion potential soils traversed by open motorized system routes, and Table 3.8-2 now shows the acres of sensitive soils, rather than the miles of open motorized routes on sensitive soils. Loss of soil productivity is the primary concern for the soil resource regardless of soil sensitivity. Soil productivity was initially lost when the motorized routes were constructed. Analysis was only completed for existing motorized routes

located on high erosion potential soils since prolonged erosion on these soil types can lead to watershed degradation.

- Section 3.8.4 A (Effects Common to All Action Alternatives). Discussion of effects associated with over-snow vehicle use was added.
- Section 3.8.4 B (Direct and Indirect Effects). Rewritten to improve clarity and organization, and to reflect the change in the measurement indicators. The analysis for existing motorized routes located on sensitive soils was modified. Analysis was conducted to determine the soil productivity loss associated with new construction, and the impacts to acres of sensitive soils from motorized access to dispersed camping sites. Table 3.8-3 is now Table 3.8-4; replaced Table 3.8-3 with a new table, and added Tables 3.8-5 and 3.8-6.
- Section 3.8.4 C (Cumulative Effects). Effects associated with over-snow vehicle use were added.
- Section 3.8.5 (Consistency with Forest Plan, Laws, and Regulations). Rewritten to provide clarity and organization.